Fertilization Has No Influence on Growth and Flowering of *Eustoma grandiflorum* (Raf.) Shinners Grown as Cut Flower

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Summary

The fertilization of *Eustoma grandiflorum* (Raf.) Shinners grown in container in ornamental plant production is often empirically based. Previous research shows that the application of chitosan or cultivation technique like nutrient film technique (NFT) improved the performance of the treated cultivars. In order to further improve our knowledge of plant requirements, we measured the growth and flowering of two *Eustoma grandiflorum* cultivars upon the application of liquid mineral fertilizer „Fertina P" in the 1.5 and 3% concentration. The addition of fertilizer which contains inorganic salts had no impact on the growth and flowering of two tested cultivars 'Flamenco Pecotee Blue' and 'Mariachi Blue'.

Key words

cut flower production, *Eustoma grandiflorum* (Raf.) Shinners, fertilization

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Introduction

The species *Eustoma grandiflorum* (Raf.) Shinners (syn. *Lisianthus russelianus*), known as Prairie gentian, lisianthus, Texas bluebell, Tulip gentian, bluebells, or lira de san Pedro, is a herbaceous annual, interesting as a new species for the cut flower market (Pertwee, 2000). It grows from 15 to 60 cm in height, has bluish green, slightly succulent leaves, and large funnel shaped flowers growing on long straight stems. Genus *Eustoma* originates from warm regions of the Southern United States, Mexico, Caribbean and northern South America (Armitage, 1993). *Eustoma grandiflorum* is particularly popular and has a number of cultivars that are grown for the cut flower market, but it can also be grown as a pot plant. In flower production there is always a search for the ways to make a better use of cultivation space, to shorten the growing season, and to appear at the market with an appealing product when the demand for it is at its highest level. Balanced nutrition is an important tool in cultivation and flowering-induction of ornamental plants (Dufour and Guérin, 2005; Clemens and Morton, 1999; Verlinden and McDonald, 2007; Chau et al., 2005). For intensive cultivation of cut flowers the choice of substrate and fertilizer is very important. Ohta et al. (1999, 2000, 2001) found out that the application of chitosan (1% w/w) enhanced shoot length, stem diameter, weight and number of cut flowers in treated *Eustoma grandiflorum* plants. Apart from chitosan, there are other organic nitrogenous substances like tryptone, casein, collagen or gelatin, the application of which enhance leaf length and width (Ohta et al., 2004.) Backes et al. (2007) used three nutrient solutions, Test, modified Steiner and Barbosa, to test the application of nutrient film technique (NTF) on four *Eustoma grandiflorum* cultivars. The effect of the technique was dependent on the cultivar. Superior (shorter) length of production, which is a very important parameter in cut flowers production, was achieved with three cultivars. Besides, the technique also enhanced the height of the stem, number of leaves, diameter of the bud flower and fresh and dry weight of Echo Champagne cultivar and number of flowers of Avila Blue Rim cultivar. Islam et al. (2004) investigated the influence of fertilization with Ca fertilizer on physiological leaf disorder called "tipburn" which reduces the quality of Eustoma cut flowers produced in greenhouses. Leaves affected by this disorder had lower Ca levels. Researchers tested the effect of several parameters on the incidence of the disorder. High concentrations of Ca in fertilizer increased Ca levels in leaves, but had little or no effect on the incidence of tipburn. Tipburn in Eustoma was therefore associated with high air humidity.

The objective of this work was to determine the effect of double application of topdressing with liquid mineral fertilizer on the growth and flowering of two *Eustoma grandiflorum* (Raf.) Shinners cultivars, the 'Mariachi Blue' and the 'Flamenco Pecotee Blue' grown as cut flowers in the late summer period.

Materials and methods

Influence of fertilization on the growth and flowering of two *Eustoma grandiflorum* (Raf.) cultivars was tested. First cultivar was the 'Flamenco Pecotee Blue' that belongs to the group of big-flowered cultivars. The flower has a simple form, white with blue trimmed petals, and it blooms in July and August. The second cultivar was the 'Mariachi Blue', which also belongs to the group of big-flowered cultivars. The form of the flower is full, it has single blue petals, and it blooms in July and August. Each cultivar was represented with 90 pieces of seedlings. Plastic containers with a 12 cm diameter filled with "Klasman 1" have been used for planting, one pot for each seedling. In the beginning of June, when seedlings developed 4 to 6 pairs of leaves, they were replanted into the same substrate. Chemical content of the substrate "Klasman 1" was: 96% of vol. high turf, and the nutrients: 100-200 mg N l^{-1}, 120 – 220 mg P_2O_5 l^{-1}, 140 – 240 mg K_2O l^{-1}, 60 – 100 mg MgO l^{-1}, 0.7 – 1.3 g l^{-1} of salt, and a pH ($CaCl_2$) 5 – 6. Topdressing was applied twice, the first nutrition was applied eight days after the planting, and the second one 23 days after the planting. Each plant was given 0.2 dl of liquid mineral fertilizer solution of the appropriate concentration (1.5 or 3%) through nutrition. Liquid mineral fertilizer "Fertina P" produced by INA Petrokemija Kutina was used for reinforcement of nutrition. The chemical composition was NPK-Mg: 10-5-4-2 +B (0.01%), Cu (0.002%), Fe (0.02%), Zn (0.002%), and Mn (0.01%). The experiment was set up according to the randomized block scheme in five replications, with six combinations involving six plants each. Plant height was measured and buds counted on the 23rd and 36th day of the experiment. Data obtained were processed by the analysis of variance and Duncan's multiple range test.

Results and discussion

The 'Mariachi' cultivar proved to be taller and developed a larger number of buds per plant than 'Flamenco' cultivar (Fig 1, Fig 2). However, there was no statistical difference in the plant height and number of buds in respect to fertilizing, neither in the first (Fig 1a, Fig 2a) nor in the second measurement of tested traits (Fig 1b, Fig 2b), showing that ascending concentrations of fertilizer did not have any impact on the performance of these cultivars grown during the period of 36 days.

For economical cut flower production, the effect of different fertilizers and fertilizing techniques should be tested for each species and even for different cultivars. In the fertilization experiment with the *Rannunculus* spe-

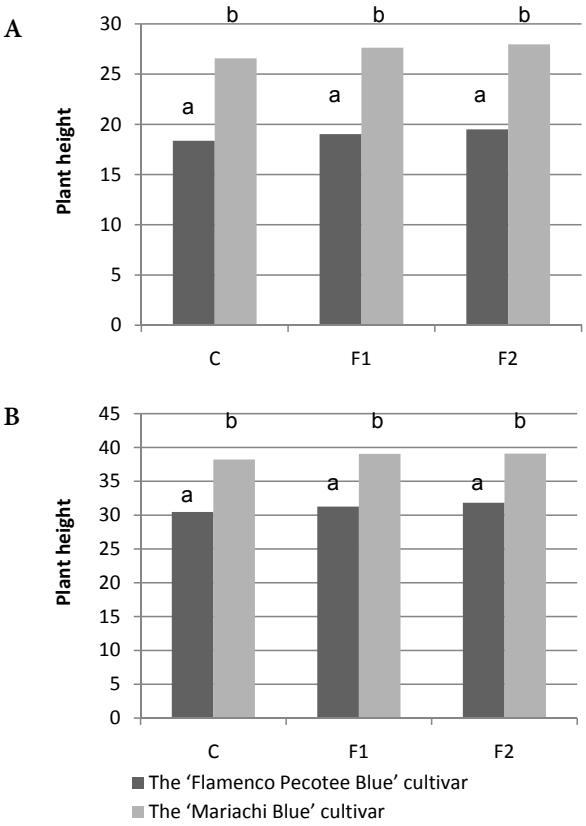

Figure 1. Influence of fertilization on the plant height of the 'Flamenco' and the 'Mariachi' cultivars measured 23 (A) and 36 (B) days after the inoculation of plants in the substrate. Note: C=control, untreated plants; F1=plants treated with 1.5% solution of fertilizer "Fertina P"; F2=plants treated with 3% solution of fertilizer "Fertina P". Means labeled with the identical letters are not significantly different at the 95% level of confidence (Duncan's multiple range test).

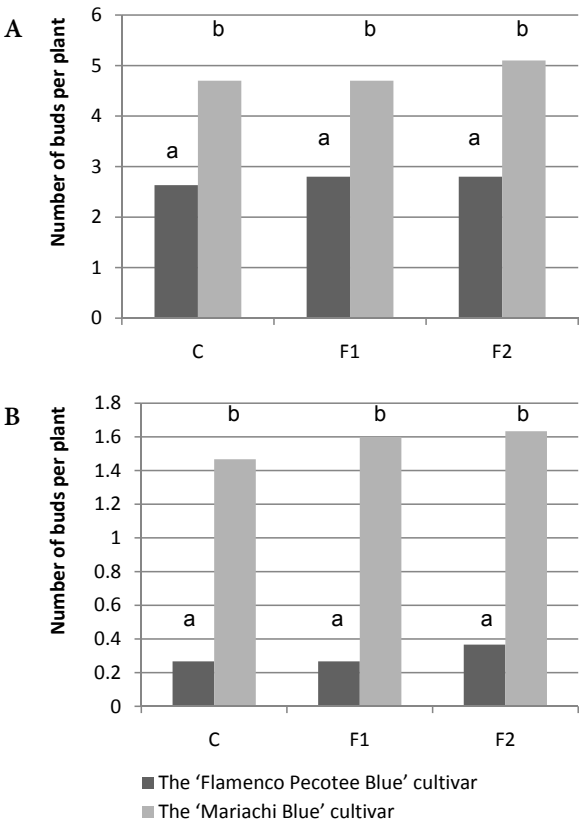

Figure 2. Influence of fertilization on the number of buds per plant for the 'Flamenco' and the 'Mariachi' cultivars measured 23 (A) and 36 (B) 36 days after the inoculation of plants in the substrate. Note: C=control, untreated plants; F1=plants treated with 1.5% solution of fertilizer "Fertina P"; F2=plants treated with 3% solution of fertilizer "Fertina P". Means labeled with the identical letters are not significantly different at the 95% level of confidence (Duncan's multiple range test).

cies, Bernstein et al. (2005) reported taller plants when using fertilizer. In production of Amaryllis (*Hippeastrum* spp.) where flowers depend on the bulb size, nitrogen and potassium fertilization significantly contributed to bulb growth, especially with higher CO_2 concentration in the greenhouse (Silberbush et al., 2003). Cut flower production of Alstroemeria was not affected by Ca supply added to top water but increased with N supply (28.5 mmol L^{-1}). Higher concentration of nitrogen in nutrient solution decreased the number of stems per plant (Smith et al., 1998). In field production of gladiolus Huang et al. (1993) found out that the higher rates of phosphorus had little positive effect on yield. Čustić and Poljak (1994) reported equal growth of *Tagetes* plants on different concentrations of fertilizer. The flowering of moth orchid (*Phalaenopsis*) was not affected by phosphorus-treatment, but continuous application of adequate N fertilizer was important for optimal flowering (Wang, 2000).

In our experiments with *Eustoma grandiflorum*, fertilizer "Fertina P" had no influence on growth and flowering of two tested cultivars, implying that the addition of inorganic salts is not necessary for the short period of cut flowers production. However, in previous research it was shown that the addition of some other substances like chitosan (Ohta et al., 1999; 2000; 2001) or the use of alternative production method like nutrient film technique (NTF) (Backes et al., 2007) could have beneficial effects on *Eustoma grandiflorum* plants, but still with differential effect on different cultivars. The possible reason why fertilizer "Fertina P" had no influence on the performance of two *Eustoma grandiflorum* cultivars tested in our experiment might also be the use of rich substrate, which itself supplied enough mineral nutrition to the plants. Therefore, there is a possibility that, if combined with the poorer substrate, fertilizing with "Fertina P" could influence the performance of *Eustoma grandiflorum* cultivars.

Conclusions

Previous research done by different authors and our results imply that for economical production of cut flowers the effect of fertilizers should be tested for each species. Plant need for inorganic salts is often overestimated in cut flower production. Fertina P fertilizer had no effect on the performance of two tested *Eustoma grandiflorum* cultivars, but use of some other fertilizers and growing techniques successfully improved the growth and flowering of the majority of tested *Eustoma grandiflorum* cultivars.

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